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# SCIENCE

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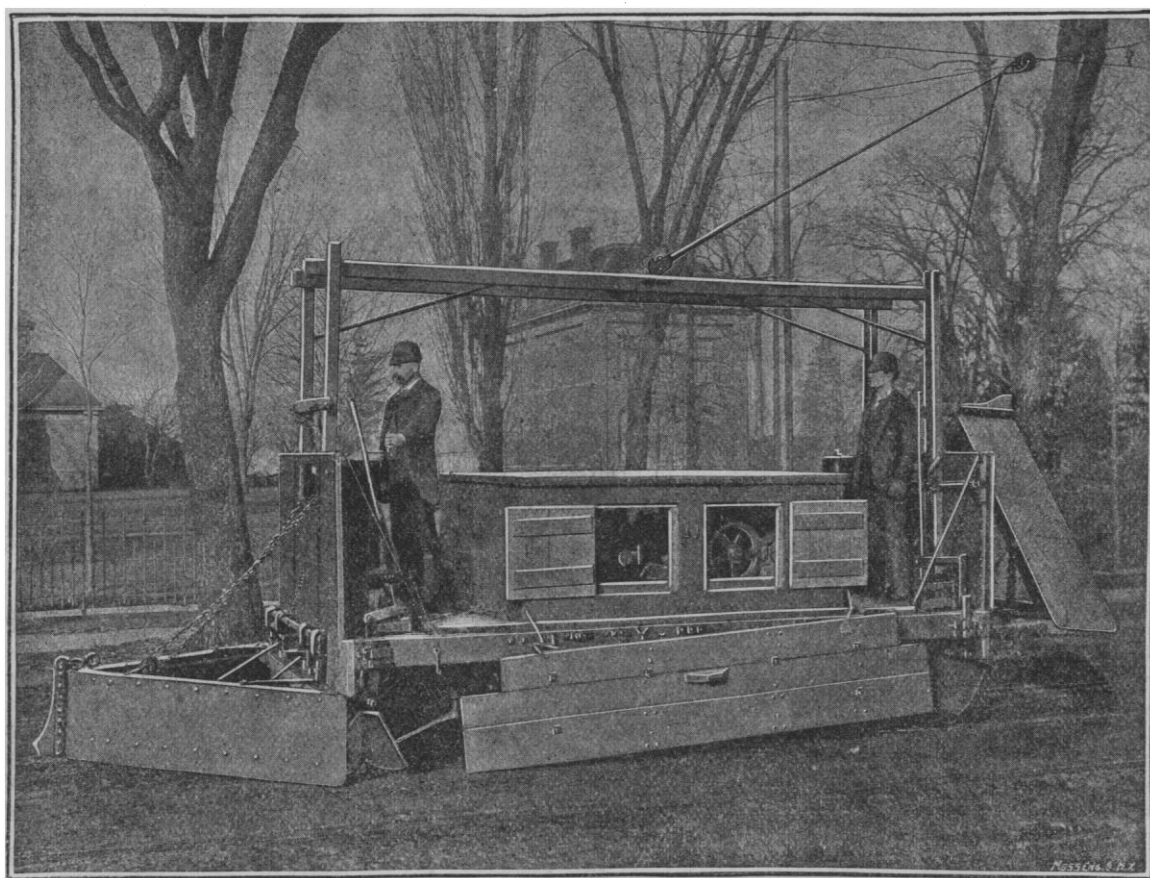
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## AN ELECTRIC SNOW-PLOUGH.

THE rapidity with which the electric motor is displacing the horse as a motive power for street-cars is greater than is generally supposed. Some idea of the transition going on may be gathered from the fact that one company alone, the Sprague, has sold about eight hundred electric motors in the last sixty days, all for street-car purposes. When we consider that this is the record of only one out of the many electric motor com-

forward or backward, similar to an electric car. The reduction in gearing between the motors and the car-axles is greater than in the ordinary electric car, so that a large amount of power is available from the motors in case of necessity. It is estimated that this plough will clear the track more speedily and effectually than an ordinary snow-plough drawn by twelve horses.

The view shown is from a photograph of a plough which has been in operation for some time on a street-railway in Troy, N.Y. Although the season has not as yet offered much chance



SPRAGUE ELECTRIC SNOW-PLOUGH FOR STREET-RAILWAYS.

panies in the field, the rapid growth of this branch of applied science seems little short of marvellous

The greater number of these electric railways are in the northern part of the country, where, during the winter months, snow often becomes a serious obstacle to travel. To rapidly and economically remove this obstacle from the tracks as soon as possible after each snow-storm, electric snow-ploughs have been constructed, one of which, manufactured by the Sprague Electric Railway and Motor Company, is shown in the accompanying illustration. It is fitted with two fifteen horse-power improved motors, and is so arranged that it can be run either

to show the capabilities of the plough, it has effectually taken care of several light falls of snow which have obstructed the tracks this winter.

## THE HALE PATENT PAVEMENT.

THE Hale pavement, shown in section in the accompanying illustration, consists essentially of a shell of hard-burned bricks laid upon a board floor having a bed of sand below and above it. It is constructed in the following manner. The grade having been properly reduced and dressed to the required

shape, the ground is covered with a layer of loose sand a few inches in thickness, to form a more perfect bed for the boards to rest upon, and to keep the boards from contact with the earth beneath, so as to form a sub-drainage against the effects of freezing weather. The sand is struck off to a perfect surface by a templet made to suit the desired curve, and guided by slats set to grade stakes.

The boards to be used need not be more than one inch in thickness, and ought not to be less than ten inches in width. The best timber for the purpose is that least subject to rot under the circumstances. Good white oak has been used successfully. The boards should be dipped in hot coal-tar or other preserving material. They are then carefully laid upon the sand-bed—lengthwise with the street would be the most convenient way—from curb to curb, with a regular curve all the way. No gutters are necessary, except such as are formed by the crown of the pavement. The broad surfaces of the boards bridge over all minor irregularities of the grading, and widely distribute all weights or pressure; and the floor forms a complete and perfect foundation for the hard material to follow. It is best to cover the boards with a layer of loose sand an inch or two in thickness, to form a more perfect bed for the bricks, which can be struck off with the templet, as before described.

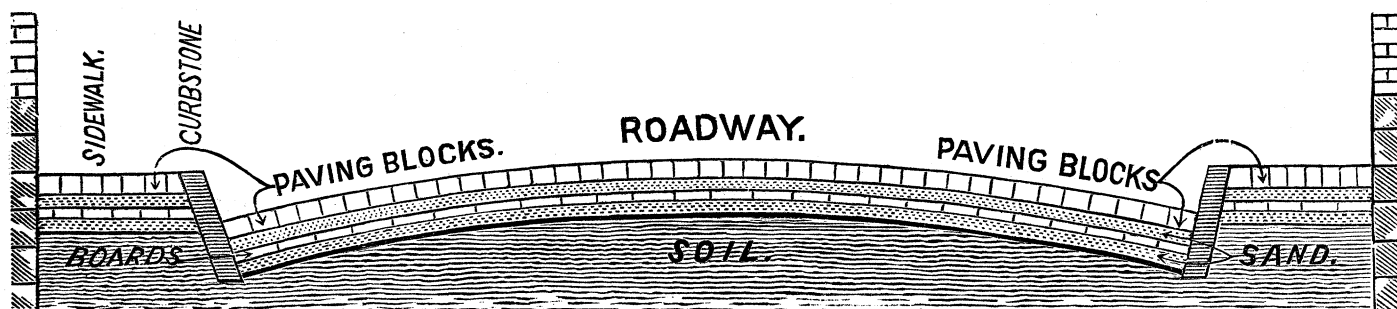
The hard-burned bricks are next laid down. If they are of the ordinary shape of building-bricks in common use, they should be placed on edge, and laid "herring-bone" style, by

blocks, and in most places for less than well-laid wooden blocks, or even good macadam roadways. It is controlled by the Hale Pavement Company of Staunton, Va.

#### MAJOR POWELL'S ADDRESS TO THE MINING ENGINEERS.<sup>1</sup>

MR. PRESIDENT, AND MEMBERS OF THE INSTITUTE OF MINING ENGINEERS,—It is with great pleasure that I greet you, and welcome you to Washington. The people of the United States obtain vast values from the rocks. The sum of the annual products of the mines of the United States is now more than six hundred millions of dollars. Over this production you preside. It is by your genius and skill that these industries are prosecuted. These affairs, which are confided to your guidance are not only great in themselves, but they constitute an integral part of all of the industries of the land, as they are all profoundly interdependent. The industries of manufacture, transportation, agriculture, and exchange have their interests, their prosperity, and their value to the people at large, all interwoven with the industry of mining, for the success and prosperity of which you are responsible.

Deep in the mountains lie the values which you seek; buried under the hills are the substances which you bring to light; concealed beneath the valleys are the materials which you resurrect. By your insight they are discovered. The prosperity of the land depends upon your knowledge of the structure of the earth and the secrets which lie buried in the depths of the rocks. By your knowledge and mastery over the powers of nature, all these sub-



THE HALE PAVING SYSTEM.

which means all joints in the board floor are straddled. The seams are then filled with sand, and the bricks settled in their beds with a flatter, well rammed, or rolled with a heavy roller.

In cities having very heavy traffic to follow immediately the laying of the pavement, it is sometimes preferred, after the interstices between the bricks are half filled with fine sand, to complete the filling with hot pitch made by boiling gas-tar until the more volatile portions are driven off. This, when it cools, makes the pavement at once impervious to water, cements the bricks together, and helps to hold them firmly in place. This is generally advisable wherever clean fine sand cannot be obtained to fill the interstices.

A perceptible elasticity tends to favor the bricks when subjected to a crushing weight. The bricks being in place, their flat surfaces agreeing with each other and with the flat surface of the boards beneath, the bearings are perfect and equal: they can be broken only with difficulty, and cannot get out of place; and if at any time it is desired to lay pipes or sewers beneath the pavement, the materials, being all disconnected, can be rapidly taken up and laid aside, and as rapidly replaced at small expense, no new materials being required, and no patching to be done, every thing fitting in its place.

The durability of this pavement has been tested by several years of hard service in the streets of Charleston, W. Va., and in other places. The cost of this pavement in any given locality depends upon the cost of sand, oak or other durable boards, hard-burned brick, gas-tar, and labor at such locality; but it is claimed that it can be laid in any city or town in the United States, having length of streets sufficient to warrant the undertaking, for very much less than asphalt or Belgian granite

stances are wrested from the adamant grasp of mountain, hill, and valley, and placed in the possession of mankind. By your knowledge of the constitution of the rocks, and the various processes by which they may be transformed, these substances, so useful to mankind in the industries of civilization, are extracted, and transmuted into forms ready for the use of the people. But for your agency, the factory-wheels of the land would stop, the life of transportation would expire, the valleys of agriculture would be reforested, and the marts of exchange, now trodden by busy feet, would be clothed by a mantle of desolation.

That labor may be successful, that the ever-increasing wants of ever-increasing men may be supplied, labor must have guidance. In the centuries that have passed, tyrants have directed laborers as slaves, or held them under control as abject servants of want; but under modern culture the laborer is emancipated from slavery supported by chains and whip, and the slavery supported by want and dependence. Muscles of brawn are no longer shackled; but by your transcendent genius the powers that gleam from the sun upon the world, the powers that flow in great rivers, the powers that are concealed in banks of coal, filling the hills and mountains, the powers that lurk in the chemical re-actions of the rocks that constitute the crust of the earth,—all these powers are enslaved, all these powers are shackled, all these powers are made the servants of mankind. The crack of the lash is superseded by the glint of thought. The modern rulers are the men who control the powers of nature.

It is thus that the members of the American Institute of Mining Engineers constitute the greatest body of rulers now on the globe. When we consider the power that is wielded as a boon to mankind, there is no other parliament or congress whose delib-

<sup>1</sup> Delivered in Washington, D.C., Feb. 19.